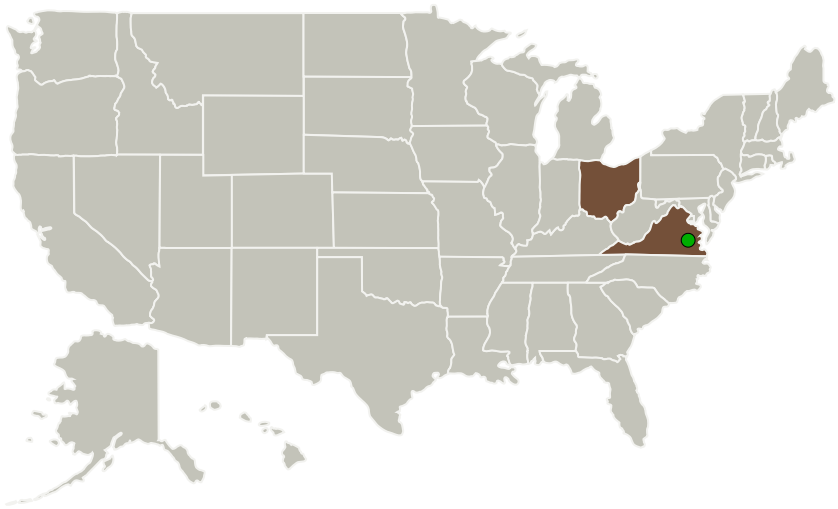
Silicon Carbide Semiconductor Surface Dielectric Barrier Discharge (SSDBD) Device for Turbulent Skin Friction Drag Reduction and Flow Control, Phase I

Completed Technology Project (2013 - 2013)

Project Introduction

The proposed research effort explores the use of a nanosecond pulse driven offset semiconducting surface dielectric barrier discharge (SSDBD) device for the control of high speed, near surface air flows and the reduction of skin friction drag. With the nanosecond discharge, very high field strengths are applied and then the field is turned off before glow-to-filamentary transition occurs. The semiconducting surface array suppresses the backward breakdown that has previously been shown to produce a cancelling backward jet leading to very little thrust for conventional nanosecond driven devices. The embedded semiconductors achieve this by conducting the backward current through the surface and thus eliminating the backward breakdown. This allows all the momentum produced in the forward direction to be delivered to the surrounding boundary layer flow field. Conventional sinusoidal driven Surface DBD's are capable of generating surface jets with velocities up to ~10 meter per second, limited by glow-to-filamentary transition of the discharge. The proposed SBIR work will explore the possibility of increasing the surface jet velocity by more than a factor of five. In addition, the SSDBD can be driven at a very high repetition rate, producing high repetition sequential surface jets and total thrust that are expected to be orders of magnitude higher than possible with conventional sinusoidal DBD configurations. These surface jets are expected to provide new methods for the control of boundary layer interactions including separation, transition to turbulence, and drag through the introduction of time varying momentum at selected locations close to the surface.

Primary U.S. Work Locations and Key Partners



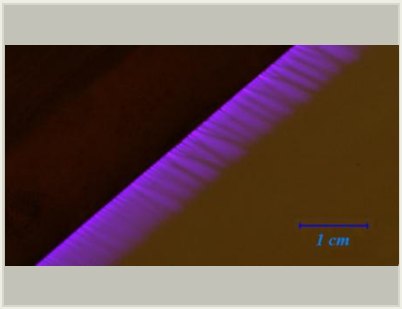


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Table of Contents

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Organizations Performing Work	Role	Type	Location
Spectral Energies, LLC	Lead Organization	Industry Small Disadvantaged Business (SDB)	Dayton, Ohio
Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations	
Ohio	Virginia

Project Transitions

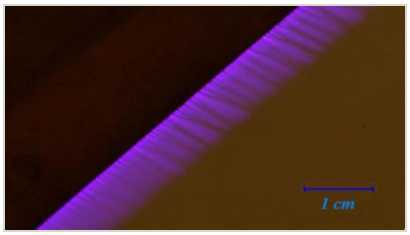
May 2013: Project Start

November 2013: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/138501)*

Images



Project Image
Silicon Carbide Semiconductor Surface Dielectric Barrier Discharge (SSDBD) Device for Turbulent Skin Friction Drag Reduction and Flow Control
(https://techport.nasa.gov/image/129483)

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
Spectral Energies, LLC

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Sivaram Gogineni

Co-Investigator:
Sivaram Gogineni

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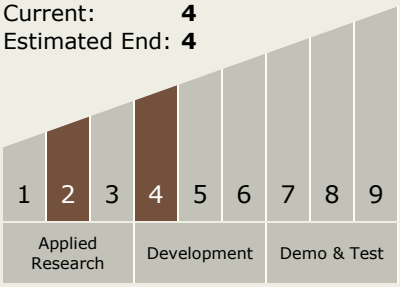
Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **4**



Technology Areas

Primary:

- TX15 Flight Vehicle Systems
  - TX15.1 Aerosciences
    - TX15.1.5 Propulsion Flowpath and Interactions

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System